

TERTIARY FRESH WATER FISHES FROM SOUTHERN QUEENSLAND.

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(Plates XVIII-XXV; Text-figures 1-14.)

INTRODUCTION.—Fossil fishes have for a number of years been known to occur in Southern Queensland, in freshwater deposits which, with some reservations, are generally considered to be Tertiary (*see* Jones, 1926). No detailed account of them has, however, previously appeared, and interest attaches both to the recognition of the fossil species, as representatives of a former piscine fauna in Queensland, and to the possibility of their yielding more precise information as to the age of the beds in which they occur.

The bulk—39 specimens—of the material described below was collected by Dr. F. W. Whitehouse at Redbank Plains, from the two adjacent properties, Portion 172, Parish of Bundamba and Portion 37, Parish of Stapylton. In addition there are three fragments from Cooper's Plains, also collected by Dr. Whitehouse, one from a well in the Parish of Bundamba, and some crushed fragments from oil shales near Brisbane collected by Mr. L. C. Ball. I have also examined a specimen from Redbank Plains in the British Museum (Nat. Hist.), London, as well as two specimens from the same locality lent to me by the Geological Survey of Queensland. The present communication is therefore essentially a description of the fishes of the Redbank Plains Series. I have not seen the remains recorded by Dunstan (1901; 1916) from the Duinga district, nor the Ceratodont tooth from Eight Mile Plains recorded by Jack and Etheridge as *Ceratodus forsteri* (1892, pp. 647, 740), these being the only other recorded examples of (?) Tertiary fresh-water fish in Queensland. David's reference (1932, Table I—Upper Oligocene) to the occurrence of "numerous fossil fish (*Epiceratodus*, etc.)" in the Oxley district refers doubtless to Redbank Plains. At Nimbin, in Northern New South Wales, there are freshwater carbonaceous shales presumably of Tertiary age, from which Smith Woodward (1902) has recorded *Ctenolates avus* Woodward, the only other record of a freshwater fish from the Tertiary of Australia known to me.

Systematic Descriptions.

Subclass **DIPNEUSTI.**

Order SIRENOIDEI.

Family CERATODONTIDÆ.

Genus **EPICERATODUS** TELLER, 1891.

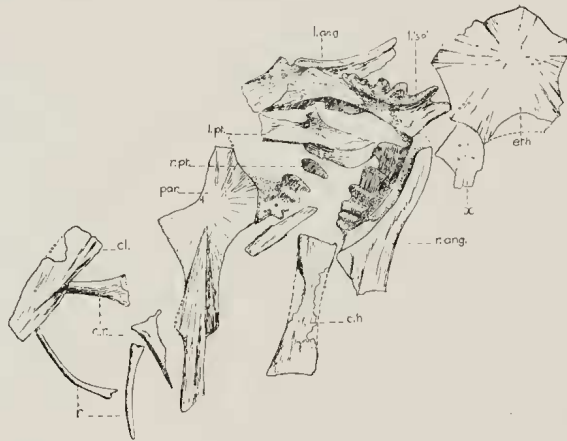
EPICERATODUS DENTICULATUS sp. nov.

(Text-figures 1 and 2.)

Locality.—Redbank Plains.

Material.—[RP/E]* Five specimens preserved as moulds in concretionary limonitic mudstone. Holotype. No. 1.

Description.—Both the palatine and “splenial” dental plates are separate, and bear five well-defined comb ridges, and what may be a sixth, ill-defined, posteriorly. The ridges are striated parallel to the edge of the plate, and on a few of them, but not all, four or five denticles are present on the outer edge. The left “splenial” plate in specimen No. 1 (see Fig. 1), is abnormal, the fourth comb ridge being atrophied.



Text-figure 1.—*Epiceratodus denticulatus* sp. nov. [RP/E] l. $\times \frac{1}{2}$ (approx.) No. F. 2347, Qld. Mus. Coll. Holotype. Drawn from a jelly mould. *ch*, cerato-hyal; *cl*, cleithrum; *c. r.*, cranial ribs; *eth*, ethmoid (?); *l. ang.* left angular; *l. pt.* left palatine; *l. "sp."* left “splenial”; *par*, parasphenoid; *r.*, ribs; *r. ang.* right angular; *r. pt.* right palatine; *x*, dermal bone.

The bone labelled ethmoid (?) in Fig. 1 clearly belongs to the median series of dermal cranial bones, but does not match either the so-called ethmoid or the occipital in *E. forsteri* (Kreff). The degree of ossification throughout is the same as in the type species, and the skeletal elements preserved, including the scales, are indistinguishable from those of that species (see Text-figs. 1 and 2). In the tail, the axonosts are slender and hollow ended, and the bascosts, which are overlapped by the thin and flexible but unjointed dermatichia, are weakly developed.

* Letters in brackets refer to labels on the specimens. Letters above the line refer to the localities—thus RP = Redbank Plains, CP = Cooper's Plains; letters below the line refer to the genus—thus E = *Epiceratodus*, B = *Phareodus*, N = *Notogoneus*, and P = *Percalates*. Counterparts are marked *a*, *b*, respectively.

TABLE I.—THE SPECIES OF EPICERATODUS.

Species.	Age.	No. of Combs.	Denticles.	Size.	Remarks.
<i>E. forsteri</i> (Kreffit) 1870	.. Pleist.—Recent	(5)–7	—	Medium	Living
<i>E. palmeri</i> (Kreffit) 1874	.. Pleist.	(?)	—	Large	Teeth only known
<i>E. gregoryi</i> White, 1925	.. Pleist.	7–8	—	Large	Teeth only known
<i>E. cyrensis</i> White, 1925	.. Pleist.	7–8	+	Medium	Teeth only known
<i>E. pattinsonae</i> White, 1926	.. Upper Cret.	6	—	Medium	Palatine tooth only known
<i>E. denticulatus</i> sp. nov.	.. Oligo.	5–(6)	+	Small	Teeth and other skeletal parts known



Text-figure 2.—*Epiceratodus denticulatus* sp. nov. Specimen in the British Museum $\times \frac{1}{2}$.
ax., axonosts; *ba*, baseosts; *de*, dermatrichia; *n. a.*, neural and haemal arches.

Remarks.—*E. denticulatus* is very close to *E. forsteri*. The presence or absence of denticles on the comb ridges is considered by Peyer (1925, p. 13) not to be a feature of classificatory importance, as they may be present or not, in what is regarded as the same species. Such is the case with *C. africanus* Haug, and *C. runcinatus* Plieninger. In *E. forsteri*, however, although the outer edges of the combs are somewhat serrated, no well-defined denticles are present. With regard to the number of comb ridges, Longman (1928) has recorded an aberrant example of *E. forsteri* possessing only five, but the possibilities are that in *E. denticulatus* the smaller number was the rule, and

not the exception. From *E. pattinsonae* the species is distinguished principally by the possession of narrower comb ridges, of a stouter first comb ridge on the splenial plate, and by the fact that the valley separating the first from the second comb ridge on the palatine tooth is shorter than the others in *E. pattinsonae*, while this is not the case in *E. denticulatus*. The distinctions from the other known species may be gathered from the Table given above. Sufficient is not yet known of the anatomy of fossil Ceratodontidæ to clearly indicate genetic affinities, and it is to be hoped that further material will be obtained from Redbank Plains, where parts other than the teeth are found in a good state of preservation.

Super Order **TELEOSTEI.**

Order ISOSPONDYLI.

Family OSTEGLLOSSIDÆ.

Genus **PHAREODUS** LEIDY, 1873.

PHAREODUS QUEENSLANDICUS sp. nov.

(Plates XVIII-XIX; Text-figures 3-7.)

Localities.—Redbank Plains and Cooper's Plains.

Material.—[RP/B]. Thirteen specimens preserved as moulds in concretionary limonitic mudstone. Holotype, No. 7, *a*, *b*.

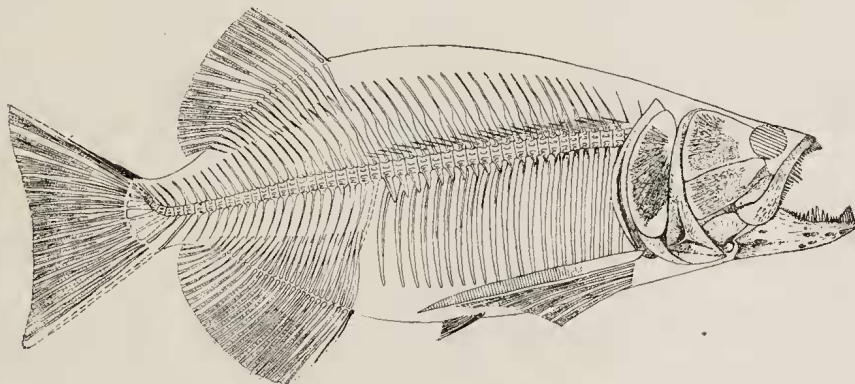
[CP/B]. Two specimens preserved as moulds in clay shale.

Description.—Moderately large fishes, estimated maximum known length about 0.5 metres. The body is less elongated than any of the living genera, resembling that of *P. acutus* Leidy, although not so deep or so blunt-snouted. The dorsal and anal fins are opposed, the dorsal somewhat shorter than the anal. The caudal is probably slightly excavated. The first pectoral ray is enormously elongated, reaching back beyond the pelvies, which are small and approximately mid-ventral.

The exact number of vertebræ is uncertain, but there are approximately 23 abdominal and 26 caudal, the last three, possibly four, being turned up into the tail. The vertebræ are ossified radially into strong longitudinal laminae. There are short parapophyses, which diminish in size anteriorly, on the posterior abdominal vertebræ. The neural spines are expanded at their bases into laminae in the median plane. Epineurals are present, but no epipleurals. The ribs are long and stout.

The anal fin is composed of 26 jointed rays, each supported by a baseost, and there are two or three anterior spines. The dorsal has probably about 19 jointed rays, and, by analogy with the anal and with *P. acutus*, probably one or more small anterior spines. Each ray corresponds to a baseost. The

caudal has about 16 jointed rays, and, to judge from the greater size of these dorsally and ventrally, was excavated at its posterior margin, which is not clearly shown in any specimen. The rays are supported by an uncertain number of hypurals. The hæmal spine attached to the seventh vertebra from the tip of the column is stronger than the others, and probably supported a robust ray or perhaps a spine in the caudal fin. There is no evidence that the enlarged first ray of the pectorals was serrated on its inner edge as Jordan (1905, p. 56) states to be the case in *P. acutus*. The pelvics have a small

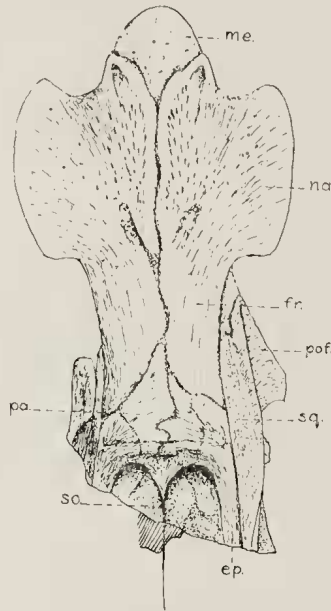


Text-figure 3.—*Phareodus queenslandicus* sp. nov. Partial reconstruction, based on Specimens [RP/B] 10, 7, 2, and [CP/B] 1.

anterior spine. The scales are of the typical Osteoglossid type, being large, granulated on the exposed surface, and divided into a mosaic of compartments.

The dermal cranial bones are sculptured, the operculum and post orbitals with grooves radiating from the growth centres and separated by rows of tubercles and fused tubercles. The cranial roof is ornamented with lineally arranged pits and grooves. The dentary is somewhat rugose. The cranial roofing bones (Fig. 4) are firmly sutured, but the sutures cannot all be made out, as in places the bones are cracked and it is difficult, from the impression, to distinguish between cracks and sutures. Comparison with the skull roof of *P. acutus* (see Plate XIX, Fig. A) and with Ridewood's figures (1905) of *Scleropages*, *Heterotis*, and *Arapaima*, brings out the close resemblance to *Phareodus*, and what is known of *Brychaetus* (see Smith Woodward, 1901, Plate I) shows that there is a general resemblance to that genus also. In the fossil genera the broad lateral and anterior expansion of the nasals and frontals, and the development of the occiput are comparable and among the living forms, the closest resemblance is with *Scleropages*. In *P. queenslandicus* no suture is visible between the nasals and frontals, and that between the frontals and parietals is more anteriorly directed than in *P. acutus* or *Brychaetus*.

The opercular series consists of a large, sub-semicircular, radially sculptured operculum, the anterior part of which is overlapped by the expanded vertical limb of the pre-operculum, and there is a sub-operculum present. The



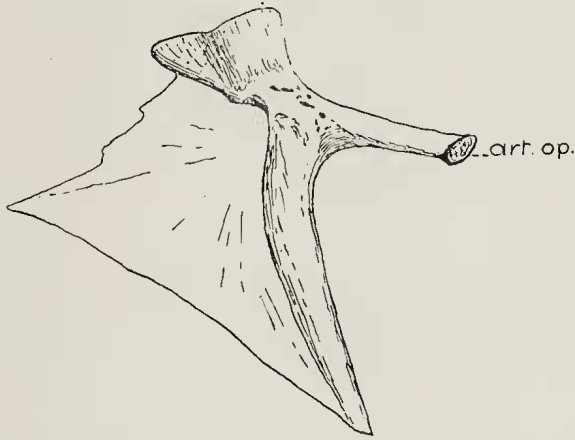
Text-figure 4.—*Phareodus queenslandicus* sp. nov. [RP/B] 2b. $\times 1$. Cranial roof. *ep*, epiotic; *fr*, frontal; *me* mesethmoid; *na*, nasal; *pa*, parietal; *pof*, post-frontal; *so*, supra-occipital; *sq*, squamosal.

two large sculptured post orbitals overlap the vertical limb of the pre-operculum. The lower post orbital is smaller than the upper. These bones are longer than



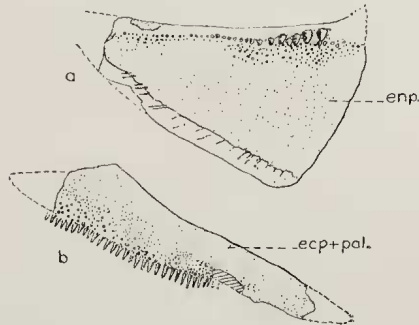
Text-figure 5.—*Phareodus queenslandicus* sp. nov. [RP/B] 1a. $\times \frac{2}{3}$. Left pre-operculum, outer aspect.

in *P. acutus* and resemble those of *Scleropages leichardti* Günther. Much of the quadrate appears to have been visible from the outside, and to judge from Tanner's figures (1925) this seems also to have been the case in *P. acutus*. The premaxilla is a small bone bearing a few large teeth, and the maxilla is large, a supplemental bone being apparently present, as in *Brychaetus*. The separate bones of the lower jaw cannot be clearly made out, but the jaw is strong and capable of a wide gape. The teeth are long, stout, hollow, and conical, those at the tip of the jaws and about the middle being larger than



Text-figure 6.—*Phareodus queenslandicus* sp. nov. [RP/B] 1b. × 1. Left hyo-mandibular, inner aspect. Art-op, opercular articulation.

the others. There are about 34 teeth on either side of the jaws, those near the angle of the gape being extremely small. The maxillary teeth are slenderer than those of the lower jaw.



Text-figure 7.—*Phareodus queenslandicus* sp. nov. a, [RP/B] 2a; b, [RP/B] 3. Right pterygoids and palatine, inner aspect × 1. *ecp + pal.*, fused ecto-ptyergoid and palatine; *enp.*, ento-ptyergoid.

Teeth are present on the pterygoids, and the surface of these bones is covered with small tubercles. The teeth are short and stout on the entopterygoid, and slenderer on the fused ectopterygoid and palatine. The pterygoids greatly resemble the corresponding bones in *Scleropages leichardti* and differ from the other living genera (see Ridewood 1905). Teeth are not present on either the parasphenoid or the vomer.

Remarks.—Fossil remains of Osteoglossids are very rare, the only other occurrences being the well-known *Phareodus* spp. in the Eocene Green River shales of Wyoming, *Brychaetus* from the London Clay (and possibly the Oligocene of Germany (Zotz, 1928) and *Phareodus* from the lower Tertiary of Sumatra. The latter is an extremely interesting recent discovery, and Dr. de Beaufort, in a personal communication, states that the Osteoglossids from Sumatra (one large specimen and some smaller ones) are “very near *Dapedoglossus*” [*Phareodus*].

Eastman (1917, p. 288) states of *Phareodus acutus*, “Its primitive characters are evident, and among surviving genera the resemblance is closest to *Heterotis* of tropical Africa.” I believe, however, that as Boulenger held (1922, p. 557) it is closest to *Scleropages*. In support of this the resemblances in the cranial osteology, which extend to the opercular series, post orbitals, jaws, pterygoids, and cranial roof, as well as the presence of the elongated first pectoral ray and the general shape of the body, are notable. As is the case with *Epiceratodus*, it seems that the fish living in Queensland represents a less differentiated survival than any other, of a previously widespread family.

Super Order **TELEOSTEI.**

Order ISOSPONDYLL.

Family GONORHYNCHIDÆ.

Genus **NOTOGONEUS** COPE, 1885.

NOTOGONEUS PARVUS sp. nov.

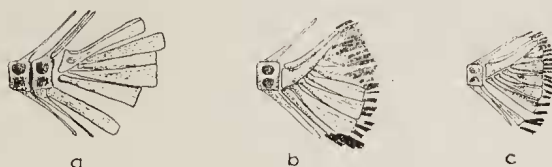
(Plate XX; Text-figures 8-9)

Locality.—Redbank Plains.

Material.—[RP/N]. Five specimens preserved as moulds in limonitic mudstone. Holotype, No. 4, *a, b*.

Description.—Small fishes, estimated maximum known length about 0.2 metres. The dorsal and pelvic fins are inserted slightly behind the middle of the fish, the dorsal just behind the pelvics; the caudal is excavated. The head is pointed, the mouth ventral, and the head and opercular apparatus are contained about four times in the total length of the fish to the tip of the tail. The length of the head exceeds the maximum depth of the body.

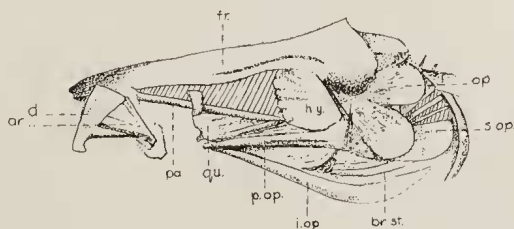
There are 14 caudal and 29 or 30 abdominal vertebrae, which bear a strong lateral ridge between deeply excavated dorsal and ventral hollows. The last vertebra is continued as a strong urostyle, to which is apposed a dorsal element covering the end of the spinal cord. There are 5 or 6 hypurals (see Fig. 8). The neural and haemal spines are slender, the ribs even more so. Intermuscular bones are present.



Text-figure 8.—*Notogoneus parvus* sp. nov. Detail of caudal fin. *a.* [RP/N] 3; *b.* [RP/N] 5; *c.* [RP/N] 4. \times about 2.

The caudal fin is slightly excavated at its posterior margin, and has about 24 jointed rays, with a few finial spines. The number of rays in the other fins is uncertain, but there are approximately ten or eleven rays and 2 or 3 small anterior spines in the dorsal, seven rays in the pelves, and eight rays and 1 or 2 spines in the anal. The rays are supported by somewhat expanded baseosts.

The scales are typically Gonorhynchid in shape, being small, subrectangular, ornamented with concentric ridges, and possessing a raised posterior border, but close examination failed to reveal denticles such as are present in other *Notogoneus* species and in *Gonorhynchus*. Scales cover the operculum and pre-operculum, and traces of these can be seen on the frontals also, so that it is possible that the head was completely covered.



Text-figure 9.—*Notogoneus parvus* sp. nov. [RP/N] 4. \times 2. No. F. 2364, Qld. Mus. Coll. Holotype. *ar*, articular; *b. st.*, branchiostegal rays; *d.*, dentary; *fr.*, frontal; *hy.*, hyo-mandibular; *i. op.*, inter-operculum; *op.*, operculum; *pa.*, parasphenoid; *p. op.*, pre-operculum; *qu.*, quadrate; *s. op.*, sub-operculum.

The operculum in one example (No. 4) bears three slits in its posterior border, in another (No. 2) four. These characteristics are regarded as of less than specific value, as no other significant differences are to be seen in the

various examples preserved. The notch in the operculum itself (*see* Fig. 9) is broader than in *N. osculus* Cope (*see* Smith Woodward, 1896) and the sub-operculum is overlapped by the operculum to a greater extent than in that species, and is also situated higher up on the head. The fact that the scales are still to be observed in this region indicates that any relative displacement of the bones has been small. The other cranial bones are very similar to those of *N. osculus* (*see* Smith Woodward, 1896 and the reconstruction given by Hüssakof, 1908). There are a few broad branchiostegal rays. No teeth were observed in any part of the skull.

Remarks.—The above remains have been referred to *Notogoneus*, in spite of the absence of denticles on the scales, because of the resemblance of the cranial and axial skeleton to that genus. Better material may reveal differences sufficient to separate the Queensland remains from *Notogoneus*, but the affinities are certainly with it rather than with *Charitosomus*.

The recognition of the presence of a Gonorhynchid in fresh water Tertiary strata in Queensland is perhaps the most interesting result of the present investigation. *Gonorhynchus*, the only living genus of the family *Gonorhynchidae*, is exclusively marine, and restricted in its occurrence to the Indian Ocean and the Western Pacific. Of the already known fossil genera, *Notogoneus* (Upper Eocene to Upper Oligocene of Western Europe and Lower Eocene of Wyoming) is elsewhere chiefly or exclusively freshwater, and *Charitosomus* (Upper Cretaceous of Mount Lebanon and Westphalia) chiefly or exclusively marine. It is certainly unexpected to find *Notogoneus* also in Queensland, and even more so to find the association of *Phareodus* and *Notogoneus* in the lower Tertiary both there and in Wyoming.

Order PERCOMORPHI.

Family MORONIDÆ.

Genus **PERCALATES** RAMSAY AND OGILBY, 1887.

PERCALATES ANTIQUUS sp. nov.

(Plates XXI–XXIV; Text-figures 10–13)

Locality.—Redbank Plains.

Material.—[RP/P]. Nineteen specimens preserved in concretionary limonitic mudstone. Holotype, No. 5 *a, b*.

Description.—Medium sized fishes, estimated maximum known length 0.25 metres. The dorsal surface from in front of the spinous dorsal to the tip of the snout is slightly concave, and the maximum depth of the body is just in front of the spinous dorsal.

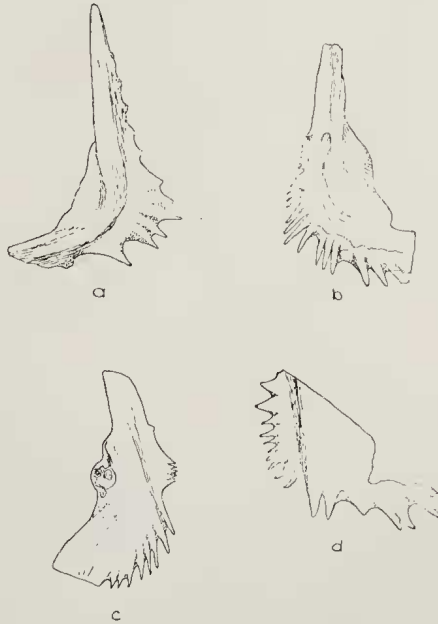
There are 30 vertebræ, 12 abdominal and 18 caudal, which are hollowed out dorsally and ventrally, leaving a strong lateral lamina. In one specimen (No. 5) the mid-caudal vertebræ are compressed, but the number remains constant (see Plate IV). The posterior ribs are attached to stout parapophyses.

There are eight spines in the spinous dorsal, the fourth being the longest. No gap separates the soft and spinous dorsals, and the soft dorsal has one anterior spine, slightly longer than the last in the spinous dorsal, and 11 or 12 jointed rays. The interneurals are laminate. The anal fin has three spines, one small anteriorly and the other two subequal and strong, and there are 9 jointed rays. In the caudal (Fig. 10) there are 17 or 18 jointed rays, with small fulcral spines dorsally and ventrally. The pelvics have a single anterior spine. The scales are moderately large, (25 in transverse series), ctenoid over



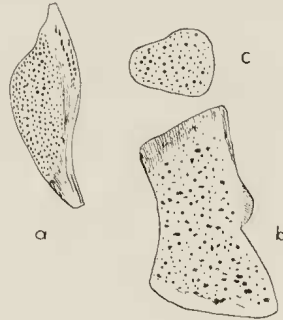
Text-figure 10.—*Percalates antiquus* sp. nov. [RP/P] 96. $\times 2$. Detail of caudal fin.

most of the body, and cycloid on the opercular apparatus. The ctenoid scales are subrectangular and the cycloid are subcircular. Both the opercles and cheeks are scaly.



Text-figure 11.—*Percalates antiquus* sp. nov. Pre-opercular bones. a, [RP/P] 15; b, [RP/P] 13; c, [RP/P] 1; d, [RP/P] 16 \times about 1.

The cranial bones do not differ markedly from those of the living *P. colonorum* (Günther). The pre-opereulum is spinous, the spines on the lower limb antrorse, but exhibiting great variations (see Fig. 11). The opereulum has two spines. The upper and lower pharyngeals (see Fig. 12), the vomer, palatines, premaxillæ, maxillæ, and dentaries bear villiform teeth. The maxilla has a supplemental bone. The sub-orbitals are serrated. The skull roof is simple, and differs little from that of *P. colonorum*. The parietals, which are



Text-figure 12.—*Percalates antiquus* sp. nov. *a*, right lower pharyngeal [RP/P] 7*b*, $\times 3/2$; *b*, *c*, upper pharyngeals; *b*, [RP/P] 12; *c*, [RP/P] 7*a*.

separated by the supraoccipitals, apparently extend round the sides of the frontals more than in that species. There are (?) six branchiostegals. The mouth is large and protrusible (see Plate XXI).



Text-figure 13.—*Percalates antiquus* sp. nov. [RP/P] 17*a*. $\times 1$. Roof of skull. *eo*, ex-occipital; *fr*, frontal; *par*, parietal; *pt*, post-temporal; *so*, supra-occipital.

Genus **PERCALATES** (?) RAMSAY AND OGILBY, 1887.

Locality.—Oil shales, West of Strathpine and East of Bald Hills, near edge of Bald Hills basin.

Material.—Fragmentary remains very much crushed. The bone is preserved in a friable condition in black carbonaceous shale.

Description.—All that can be made out is that the remains are those of a Percoid fish, the spinous dorsal, pre-operculum with spinous border, and scales with concentric and radial ornament suggesting that, in view of the probable freshwater nature of the deposit, the remains may be those of *Percalates*.

Order PERCOMORPHI.

Family MORONIDÆ.

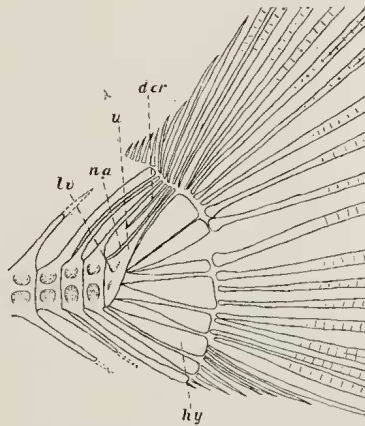
GENUS Indet.

(Plate XXV; Text-figure 14.)

Locality.—Well, Portion 122, Parish of Bundamba.

Material.—Posterior half of a very small fish, the bones replaced by translucent material (??) chalcedony) and preserved in fine shale.

Description.—The estimated length of the fish is about 5 centimetres.



Text-figure 14.—Percoid fish, genus indet., from well, Portion 122, Parish of Bundamba. $\times 4$. Detail of caudal fin.—*d. cr.*, dorsal caudal radials; *hy*, hypural; *l. v.*, last vertebra; *n. a.*, fused neural arches covering the posterior end of the spinal cord; *u*, urostyle.

The dorsal fin has 12 soft rays, the last two very small. The anal has three spines, one small anteriorly and two more, subequal and much stronger. The caudal has about 17 jointed rays and a series of dorsal and ventral fulcral

spines: whether the posterior border was rounded or excavated is uncertain. There are at least 14 abdominal vertebræ, probably more, the last three compressed. The last vertebra is continued as a urostyle, to which is apposed a cover of fused neural arches, and there is a number of hypurals (*see* Fig. 13). The scales are ctenoid, and there are about 17 in a transverse series. Neural and hæmal spines are relatively strong.

Remarks.—In the absence of the head, the fish is indeterminable. It is not certain whether it is a pigmy perch or the fry of a large fish, but I incline to the view that the latter is the case and it may be that, as the general similarity suggests, it is a young specimen of *Percalates* sp.

This specimen was labelled "Ipswich or Upper Trias Jura." Mr. Ball points out, however, that when it was collected the Tertiary beds in the Bundamba district had not been mapped, and thus there is no necessary implication that the fish came from the Triassic Ipswich Series as now known. The well is situated within the Tertiaries, and from these the fish was obtained.

Order indet.

Locality.—Cooper's Plains.

Material.—A few fragments, the bone being actually preserved, in soft mudstone.

Description.—Fragments of the axial skeleton and fin spines of a Teleostean fish, indeterminable.

Remarks.—There is an extremely close resemblance between the fossil species *P. antiquus* and the living *P. colonorum*, the greatest differences being in the number of vertebræ—25 (11+14) in the living species and 30 (12+18) in the fossil—and the variability and less regular development of the spines on the pre-operculum of the fossil species. This close similarity is somewhat unexpected in view of the presence in the same beds of a distinct genus of Osteoglossidæ from that now living in the same region, and of the Gonorhynchid *Notogoneus*, of which no living relatives inhabit fresh waters.

It seems, however, that the more primitively organised Percoid genera such as *Perciththis* and *Lates*, have changed but little throughout Tertiary time. *Percichthys*, still living in South America, occurs fossil in the Tertiary lignites of Taubaté, Brazil (Smith Woodward, 1898), and *Cyclopoma* from the Upper Eocene of Monte Bolca, Italy, is scarcely distinguishable from *Lates*, still living in Northern Africa (Smith Woodward, 1901). *Percichthys* and *Percalates* are indeed extremely alike. Boulenger (1895) separates them in his key to the family Serranidæ [s. l.] solely on the presence of cycloid scales in *Percalates* as against ctenoid in *Percichthys*. The specimens of

Percalates in the National Museum, Melbourne, however, all possess delicately ciliate etenoid scales, and Ramsay and Ogilby in their definition of the genus, state that ciliated scales are present. A means of distinction must therefore be sought in other characters. The number of vertebræ, for instance, in the living species of *Percichthys*, varies from 33–35, as against 25 in *Percalates*, although it will be noted that the fossil *Percalates antiquus* approaches *Percichthys* in this respect, possessing 30 vertebræ.

GEOLOGICAL AGE OF THE FOSSIL BEARING BEDS.

Redbank Plains Series.—Of the forms occurring here, *Phareodus* is the most restricted in time, being found in the Lower Eocene (Paleocene) Green River Shales of Wyoming, and the (?) Eocene of the Padang Highlands, Sumatra. The age of the Sumatran beds is certainly Palæogene, if not Eocene (de Beaufort, 1931, and personal communication), but it may be that the Osteoglossids from there, at present referred to *Phareodus*, are really a new, though closely allied genus. *Notogoneus* ranges from the Paleocene (Green River Shales), through the Upper Eocene (Gyps de Montmartre) to the Lower Oligocene of Aix en Provence and the Upper Oligocene of the Mainz Basin. *Percalates*, by analogy with *Cyclopoma* [Lates] and *Percichthys*, may be expected to range throughout Tertiary time. *Epiceratodus* is known to occur in the Upper Cretaceous of White Cliffs, New South Wales, but *E. denticulatus* is much closer to the Pleistocene and Recent *E. forsteri* than is the Cretaceous species.

The evidence, therefore, is strong that the Redbank Plains Series is of Palæogene age—Eocene or Oligocene—certainly not Cretaceous, as has been suggested. Beyond that it is not possible to particularise with certainty, although if, as seems possible, *Phareodus queenslandicus* should prove to be closer to *Scleropages* than to the North American species, especially *P. acutus*, an Oligocene, rather than an Eocene age would be indicated, and this would be supported by the resemblance of *Percalates antiquus* to the living species, and of *E. denticulatus* to *E. forsteri*. The Redbank Plains Series may therefore be tentatively (in view of the paucity of comparative material) referred to the Oligocene, and with this Series the beds at Cooper's Plains (with *Phareodus* and other Teleosts) are clearly to be linked (see Jones, 1926).

Bald Hills Basin.—The evidence is insufficient to indicate more than that the oil shales with fragmentary fish remains are of Kainozoic age.

I am indebted to Mr. G. Mack, of the National Museum, Melbourne, for the opportunity of studying and dissecting specimens of *Percalates*, *Gonorhynchus*, *Scleropages*, and pigmy Perches in his care.

CONCLUSION.

In *Scleropages* and *Epiceratodus*, Queensland possesses two freshwater fishes whose only living relatives are found in parts of Africa, South America, and, in the case of *Scleropages*, in the East Indies. To account for such a peculiar distribution, land connections, either continuous at one period or progressively developed throughout the Tertiary, must be postulated. In older Tertiary times the freshwater fish faunas of North America and Europe were remarkably similar. The present communication has shown that in Australia, too, the lower Tertiary freshwater fishes conform, in a general way, to the types found in those continents, and in the East Indies. If the present and past distribution of freshwater fishes is considered, the case for the former existence of land connections, in moderately low latitudes, between the chief continental masses is greatly strengthened. The evidence of the Redbank Plains fishes is particularly clear as to the existence of a pre-Oligocene land connection, bridging the Pacific Ocean, between Eastern Australia and North America.

KEY TO LETTERING USED IN THE PLATES.

<i>a</i>	.. anal fin.	<i>p. ab.</i>	.. post abdominal bone (s).
<i>ar(t)</i>	.. articular.	<i>par.</i>	.. parasphenoid.
<i>b. r.</i>	.. branchiostegal rays.	<i>p. b.</i>	.. pelvic girdle.
<i>ch(y)</i>	.. cerato-hyal.	<i>pel.</i>	.. pelvic fin
<i>c(f)</i>	.. caudal fin.	<i>p. f.</i>	.. pectoral fin.
<i>cl.</i>	.. cleithrum.	<i>p. mx.</i>	.. pre-maxilla.
<i>d(en)</i>	.. dentary.	<i>p. o. 1, 2</i>	.. first and second post-orbitals.
<i>d. f.</i>	.. dorsal fin.	<i>p. op.</i>	.. pre-operculum.
<i>eh(y)</i>	.. epi-hyal.	<i>pt.</i>	.. ecto-pterygoid.
<i>hyo.</i>	.. hyomandibular.	<i>qu.</i>	.. quadrate.
<i>fr.</i>	.. frontals.	<i>r. 1</i>	.. enlarged first pectoral ray.
<i>i. op.</i>	.. inter-operculum.	<i>s. d.</i>	.. spinous dorsal.
<i>m. pt.</i>	.. meta-pterygoid.	<i>so. d.</i>	.. soft dorsal.
<i>mx.</i>	.. maxilla.	<i>s. op.</i>	.. sub-operculum.
<i>op.</i>	.. operculum.		

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EXPLANATION OF PLATES XVIII-XXV.

PLATE XVIII.

Phareodus queenslandicus sp. nov. [RP/B] 7a. Slightly reduced. No. F. 2357, Queensland Museum Collection. Holotype.

PLATE XIX.

A. *Phareodus acutus* (Leidy). Roof of skull, to be compared with Text-figure 4. (From Eastman, 1917, Pl. 16.)

B. *Phareodus queenslandicus* sp. nov. [RP/B] 10. $\times \frac{2}{5}$. No. F. 1960, Queensland Geological Survey Museum Collection.

PLATE XX.

Notogoneus parvus sp. nov. [RP/N] 4a. $\times 2$. No. F. 2364, Queensland Museum Collection. Holotype.

PLATE XXI.

Percalates antiquus sp. nov. [RP/P] 5a. $\times \frac{3}{4}$. No. F. 2370, Queensland Museum Collection. Holotype.

PLATE XXII.

Percalates antiquus sp. nov. [RP/P] 11. $\times 1$. No. F. 2376, Queensland Museum Collection.

PLATE XXIII.

Percalates antiquus sp. nov.

A. [RP/P] 15. $\times 1$. No. F. 2380, Queensland Museum Collection.

B. [RP/P] 9b. $\times \frac{3}{4}$. No. F. 2374, Queensland Museum Collection.

PLATE XXIV.

Percalates antiquus sp. nov.

A. [RP/P] 1a. $\times 1$. No. F. 2366, Queensland Museum Collection.

B. [RP/P] 13b. $\times 1$. No. F. 2378, Queensland Museum Collection.

C. [RP/P] 13c. $\times 1$. No. F. 2378, Queensland Museum Collection.

PLATE XXV.

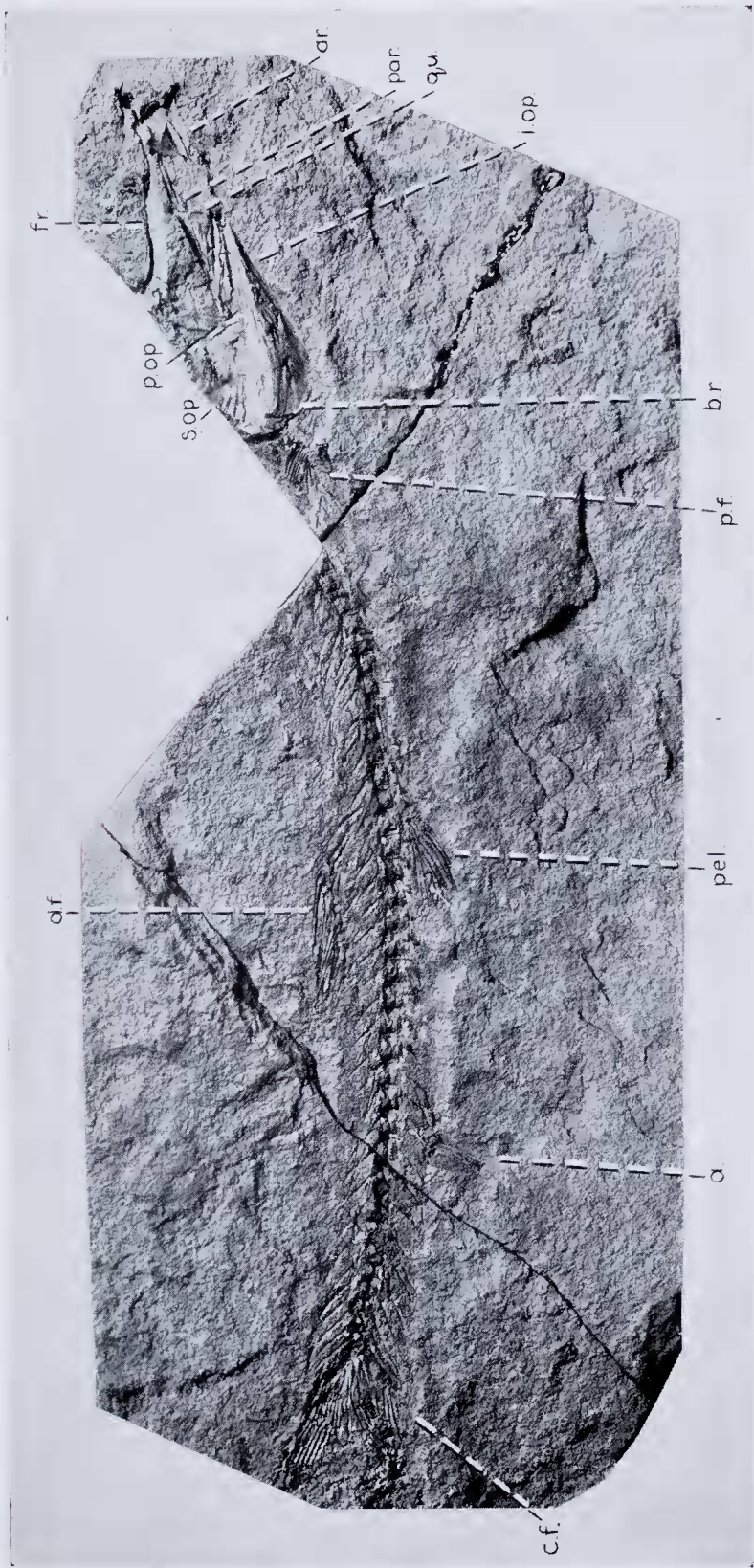
Percoid fish. Genus indet. from a well in Portion 122, Parish of Bundamba. $\times 5$. No. F. 1961, Queensland Geological Survey Museum Collection.



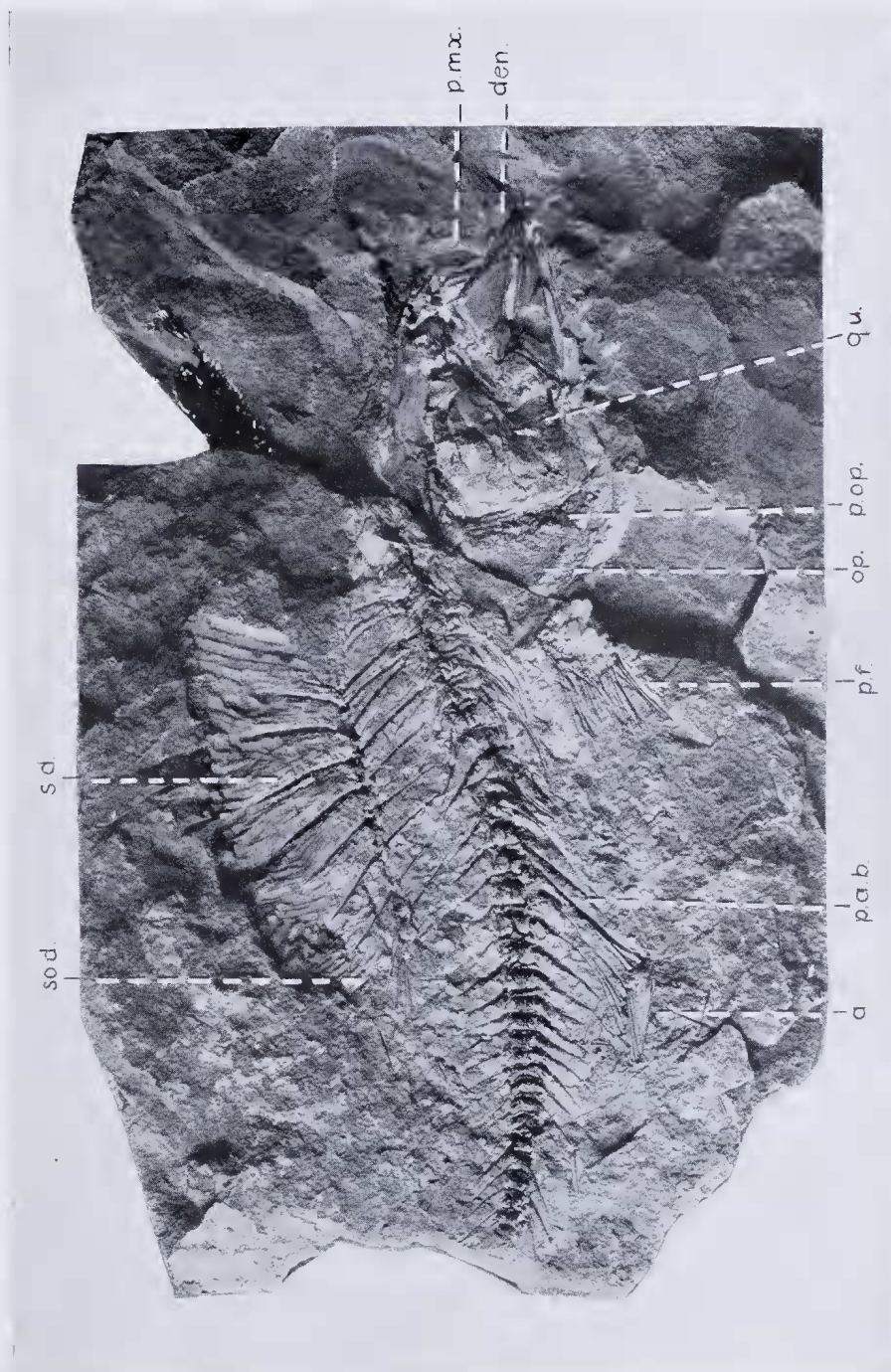
Phareodus queenstandicus sp. nov. [RP/B] 7a. Slightly reduced. No. F. 2357, Queensland Museum Collection. Holotype.



A. *Phareodus acutus* (Leidy). Roof of skull, to be compared with Text-figure 4. (From Eastman, 1917, pl. 16.)
B. *Phareodus queenstandicus* sp. nov. [RP/B] 10 × 3. No. F. 1960, Queensland Geological Survey Museum Collection.



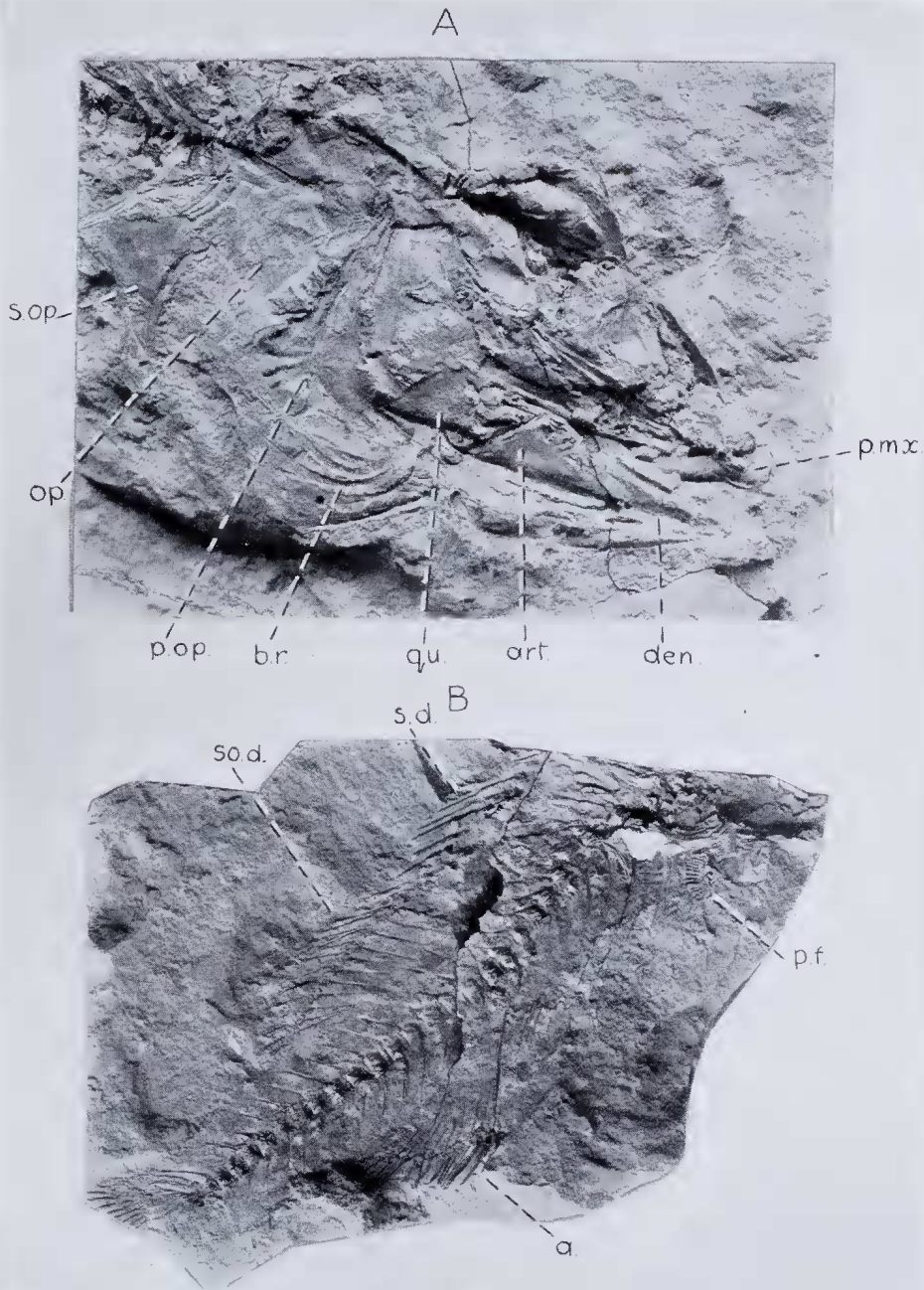
Notogoneus parvus sp. nov. [RP/N] 4a × 2. No. F. 2364. Queensland Museum Collection. Holotype.



Percalates antiquus sp. nov. [RP/P] 5a x 3. No. F. 2370. Queensland Museum Collection. Holotype.



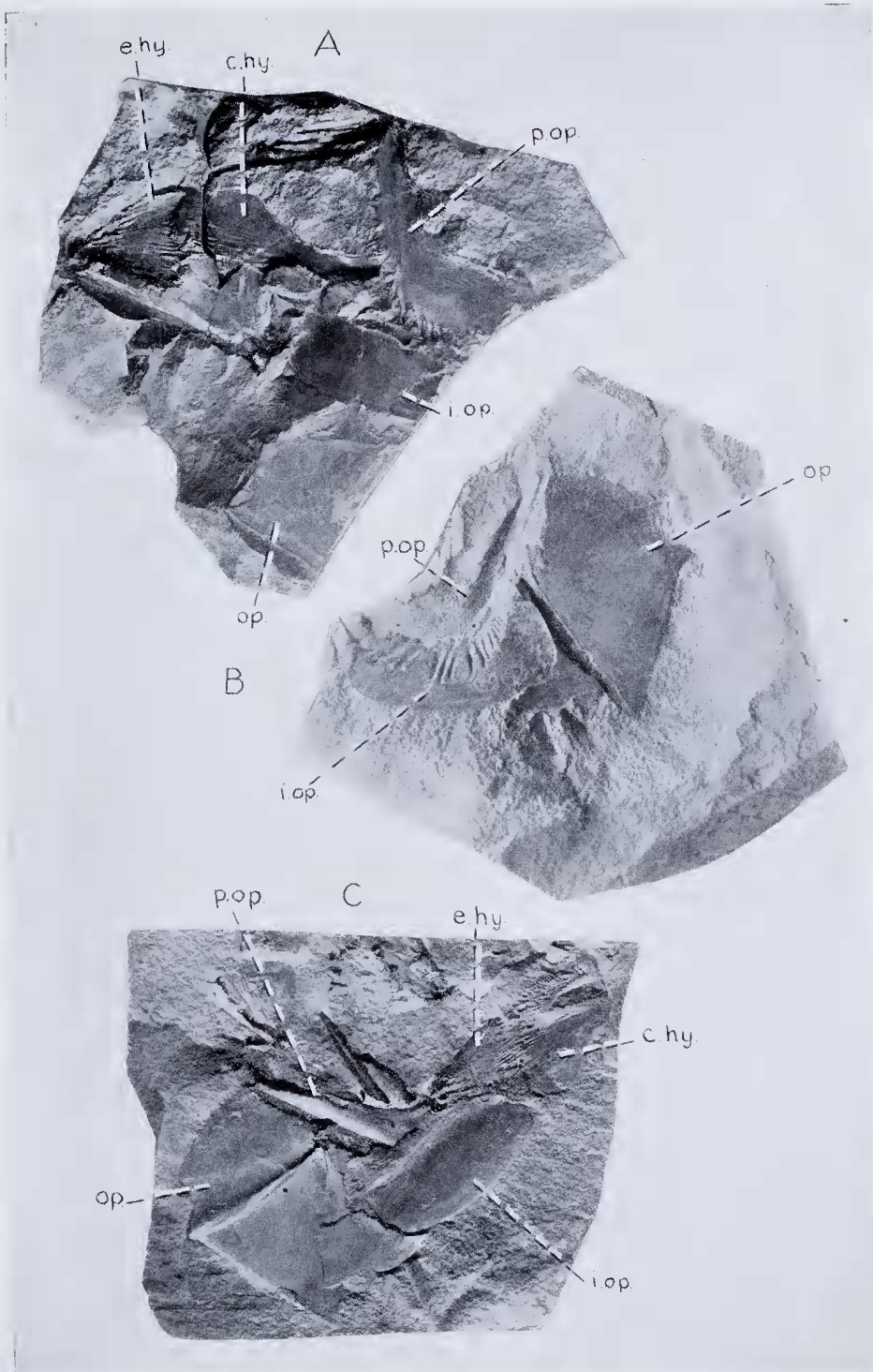
Percalates antiquus sp. nov. [RP/P] 11 x 1. No. F. 2376, Queensland Museum Collection.



Percalates antiquus sp. nov.

A. [RP/P] 15 × 1. No. F. 2380, Queensland Museum Collection.

B. [RP/P] 96 × 3. No. F. 2374, Queensland Museum Collection.



Percalates antiquus sp. nov.
A. [RP/P] 1a × 1. No. F. 2366. Queensland Museum Collection.
B. [RP/P] 13b × 1. No. F. 2378. Queensland Museum Collection.
C. [RP/P] 13c × 1. No. F. 2378. Queensland Museum Collection.



Percoid fish, genus indet., from a well in Portion 122, parish of Bundamba $\times 5$. No. F. 1961. Queensland Geological Survey Museum.